

## CLAIMS

1. A surface shape recognizing sensor device  
2 characterized by comprising:
  - 3 a plurality of sensor cells which are
  - 4 two-dimensionally arranged, detect capacitances
  - 5 corresponding to ridges and valleys of a surface of an
  - 6 object to be recognized, and output signals
  - 7 corresponding to the capacitances; and
  - 8 a signal processor which calculates a surface
  - 9 shape of the object on the basis of the signals input
  - 10 from said sensor cells,
  - 11 said sensor cell comprising:
    - 12 a substrate;
    - 13 a first electrode formed on said substrate;
    - 14 a signal output unit which outputs a signal
    - 15 corresponding to a capacitance formed between said first
    - 16 electrode and the surface of the object;
    - 17 a second electrode formed on said substrate so
    - 18 as to be insulated and isolated from said first
    - 19 electrode; and
    - 20 a potential controller which controls a
    - 21 potential of the surface of the object via a capacitance
    - 22 formed between said second electrode and the surface of
    - 23 the object by controlling a potential of said second
    - 24 electrode.
2. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that said signal

3 output unit comprises:

4 a signal generating circuit which generates a  
5 voltage signal corresponding to the capacitance formed  
6 between said first electrode and the surface of the  
7 object;

8 a charging/discharging circuit which performs  
9 one of storage and removal of an electric charge with  
10 respect to a node as a connecting point between said  
11 first electrode and an output of said signal generating  
12 circuit, before the signal is generated by said signal  
13 generating circuit; and

14 a detection circuit which detects the voltage  
15 signal output from said signal generating circuit to the  
16 node after one of the storage and removal of an electric  
17 charge is performed, and outputs the voltage signal as  
18 an output from said signal output unit.

3. A surface shape recognizing sensor device  
2 according to claim 2, characterized in that said  
3 potential controller comprises a potential control  
4 circuit which changes the potential of said second  
5 electrode in an opposite direction to a change in  
6 voltage signal output from said signal generating  
7 circuit.

4. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that said signal  
3 output unit comprises:

4 a signal generating circuit which generates a

5 voltage signal corresponding to the capacitance formed  
6 between said first electrode and the surface of the  
7 object;

8           a charging circuit which stores an electric  
9 charge in a node as a connecting point between said  
10 first electrode and an output of said signal generating  
11 circuit, before the signal is generated by said signal  
12 generating circuit; and

13           a detection circuit which detects the voltage  
14 signal output from said signal generating circuit to the  
15 node after the electric charge is stored, and outputs  
16 the voltage signal as an output from said signal output  
17 unit.

5.           A surface shape recognizing sensor device

2 according to claim 4, characterized in that

3           said signal generating circuit comprises:

4           a first current source which removes the  
5 electric charge from the node; and

6           a first switching element which is placed  
7 between the node and said first current source, and  
8 generates a voltage signal by connecting the node and  
9 said first current source for only a predetermined  
10 period after an electric charge is stored in the node,  
11 and

12           said potential controller comprises:

13           a second current source which charges said  
14 second electrode; and

15           a second switching element which is placed  
16 between said second electrode and said second current  
17 source, and controls the potential of said second  
18 electrode by connecting said second electrode and said  
19 second current source.

6.           A surface shape recognizing sensor device  
2 according to claim 5, characterized by further  
3 comprising a control signal output unit which outputs a  
4 control signal which controls said first switching  
5 element and said second switching element together.

7.           A surface shape recognizing sensor device  
2 according to claim 4, characterized in that  
3           said signal generating circuit comprises:  
4           a capacitive element including a first  
5 terminal and a second terminal, the first terminal being  
6 connected to the node; and

7           a third switching element which sets the  
8 second terminal of said capacitive element at a first  
9 potential before charging to the node is completed, and  
10 sets the second terminal at a second potential lower  
11 than the first potential after the charging is  
12 completed, thereby generating a voltage signal from said  
13 capacitive element, and

14           said potential controller comprises a setting  
15 unit which sets said second electrode at a third  
16 potential before the charging to the node is completed,  
17 and sets said second electrode at a fourth potential

18 higher than the third potential after the charging is  
19 completed, thereby controlling the potential of said  
20 second electrode.

8. A surface shape recognizing sensor device  
2 according to claim 7, characterized by further  
3 comprising a control signal output unit which outputs a  
4 control signal which controls said third switching  
5 element and said setting unit together.

9. A surface shape recognizing sensor device  
2 according to claim 2, characterized in that said  
3 potential controller comprises a potential control  
4 circuit which changes the potential of said second  
5 electrode in an opposite direction to a potential change  
6 when one of charging and discharging of the node is  
7 performed, and to a change in voltage signal output from  
8 said signal generating circuit.

10. A surface shape recognizing sensor device  
2 according to claim 4, characterized in that  
3 said signal generating circuit comprises:  
4 a first current source which removes the  
5 electric charge from the node; and  
6 a first switching element which is placed  
7 between the node and said first current source, and  
8 generates a voltage signal by connecting the node and  
9 said first current source for only a predetermined  
10 period after an electric charge is stored in the node,  
11 and

12               said potential control circuit comprises:  
13               a second current source which charges said  
14 second electrode; and  
15               a second switching element which sets said  
16 second electrode at a fifth potential before charging to  
17 the node is started, sets said second electrode at a  
18 sixth potential lower than the fifth potential when the  
19 charging is started, and then connects said second  
20 electrode and said second current source, thereby  
21 controlling the potential of said second electrode.

11.           A surface shape recognizing sensor device  
2 according to claim 4, characterized in that  
3               said signal generating circuit comprises:  
4               a capacitive element including a first  
5 terminal and a second terminal, the first terminal being  
6 connected to the node; and

7               a third switching element which sets the  
8 second terminal of said capacitive element at a first  
9 potential before charging to the node is completed, and  
10 sets the second terminal at a second potential lower  
11 than the first potential after the charging is  
12 completed, thereby generating a voltage signal from said  
13 capacitive element, and

14               said potential control circuit comprises a  
15 setting unit which sets said second electrode at a  
16 seventh potential before the charging to the node is  
17 started, sets said second electrode at an eighth

18 potential lower than the seventh potential when the  
19 charging is started, and sets said second electrode at a  
20 ninth potential higher than the eighth potential after  
21 the charging is completed, thereby controlling the  
22 potential of said second electrode.

12. A surface shape recognizing sensor device  
2 according to claim 11, characterized by further  
3 comprising a control signal output unit which outputs a  
4 control signal which controls said charging circuit and  
5 said setting unit together.

13. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that said second  
3 electrode is formed to surround said first electrode.

14. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that said first  
3 electrode is formed to surround said second electrode.

15. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that an area of  
3 said second electrode is not more than an area of said  
4 first electrode.

16. A surface shape recognizing sensor device  
2 according to claim 15, characterized in that the area of  
3 said second electrode is smaller than the area of said  
4 first electrode.

17. A surface shape recognizing sensor device  
2 according to claim 1, characterized in that said second  
3 electrode is formed at a height different from said

- 4 first electrode with respect to a surface of said
- 5 substrate.